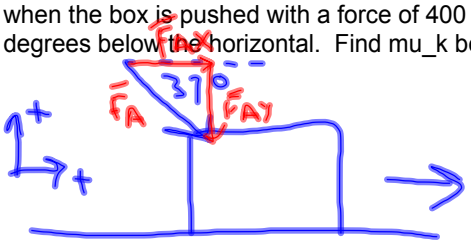
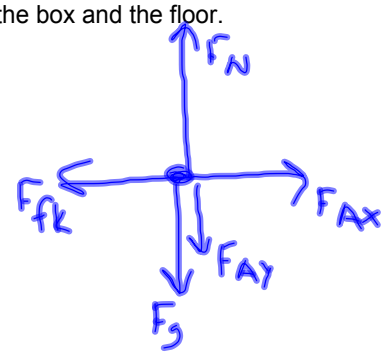
Vector Review and Practice Problems 1st Block 10.3.11

A box of books with a mass of 36.4 kg moves at a constant velocity across the floor when the box is pushed with a force of 400 N exerted downward at an angle of 37.0 degrees below the horizontal. Find mu_k between the box and the floor.





$$F_{fk} = \mu_k F_N$$

$$\mu_k = \frac{F_{fk}}{F_N}$$

$$= \frac{319\,N}{597\,N}$$

$$= 0.535$$

$$\Sigma \bar{F}_x = 0$$

$$F_{Ax} - F_{fk} = 0$$

$$F_{fk} = F_{Ax}$$

$$= F_A \cos(37°)$$

$$= 319\,N$$

$$\Sigma \bar{F}_y = 0$$

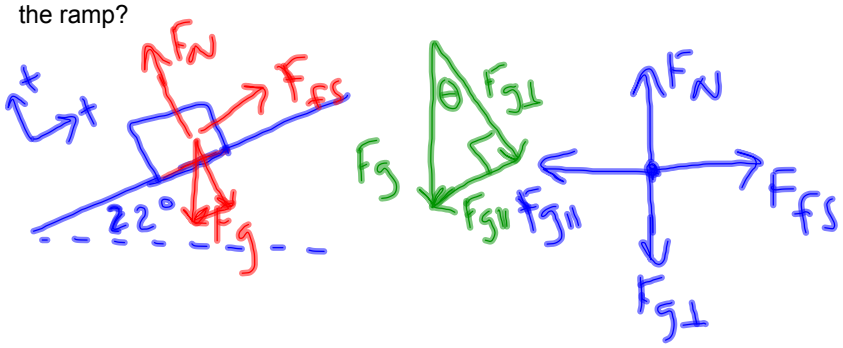
$$F_N - F_{Ay} - F_g = 0$$

$$F_N = F_{Ay} + F_g$$

$$= F_A \sin(37°) + mg$$

$$= 597\,N$$

A 5.5 kg suitcase is at rest on a ramp that is angled 22.0 degrees above the horizontal. What is the coefficient of friction between the suitcase and the surface of the ramp?



$$F_{fs} = \mu_s F_N$$

$$\mu_s = \frac{F_{fs}}{F_N}$$

$$= \frac{20.2\ N}{50.0\ N}$$

$$= .404$$

$$\Sigma \vec{F}_{\parallel} = 0$$

$$F_{fs} - F_{g\parallel} = 0$$

$$F_{fs} = F_{g\parallel}$$

$$= F_g \sin(22°)$$

$$= 20.2\ N$$

$$\Sigma \vec{F}_{\perp} = 0$$

$$F_N - F_{g\perp} = 0$$

$$F_N = F_{g\perp}$$

$$= F_g \cos(22°)$$

$$= 50.0\ N$$

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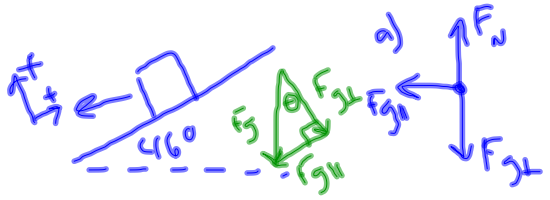
An 8.55 kg box slides down a ramp that is angled at 46.0 degrees above the horizontal.
a) If the ramp is frictionless, what is the acceleration of the box?
b) If the coefficient of friction between the box and ramp is 0.550, what is the acceleration of the box?



a) $\Sigma \bar{F}_{\parallel} = m\bar{a}_{\parallel}$

$a_{\parallel} = \frac{\Sigma F_{\parallel}}{m}$

$= \frac{F_{g\parallel}}{m}$

$= \frac{m a_g \sin\theta}{m}$

$= -7.05\ m/s^2$

b) $\Sigma \bar{F}_{\parallel} = m\bar{a}_{\parallel}$

$a_{\parallel} = \frac{\Sigma F_{\parallel}}{m}$

$= \frac{F_{fk} - F_{g\parallel}}{m}$

$= \frac{\mu_k m a_g \cos\theta - m a_g \sin\theta}{m}$

$= a_g(\mu_k \cos\theta - \sin\theta)$

$= -3.30\ m/s^2$

$F_{fk} = \mu_k F_N$

$= \mu_k m a_g \cos\theta$

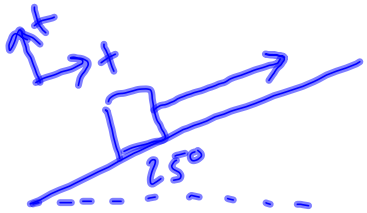
$\Sigma \bar{F}_{\perp} = 0$

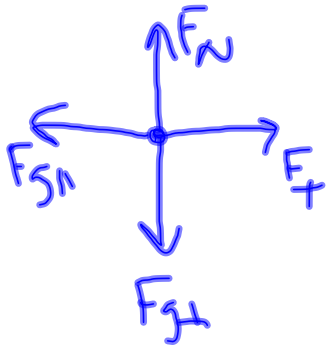
$F_N - F_{g\perp} = 0$

$F_N = F_{g\perp}$

$= m a_g \cos\theta$

A child pulls a rope attached to a sled up a 25.0 degree incline (the rope is pulled parallel to the surface of the incline), and assume the surface is frictionless. The mass of the sled is 8.00 kg and the child uses a constant force of 78.4 N. As the sled is pulled along the incline, what is the acceleration of the sled?





$$\Sigma \vec{F}_{\perp} = m\vec{a}_{\perp}$$

$$a_{\perp} = \frac{\Sigma F_{\perp}}{m}$$

$$= \frac{F_T - F_{g\perp}}{m}$$

$$= \frac{F_T - mg\sin\theta}{m}$$

$$= \frac{78.4\,N - (8.00\,kg)(9.8\,m/s^2)\sin(25^\circ)}{8.00\,kg}$$

$$= 5.66\,m/s^2$$

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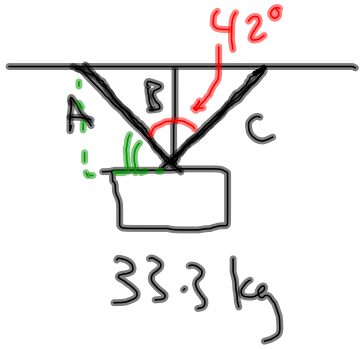
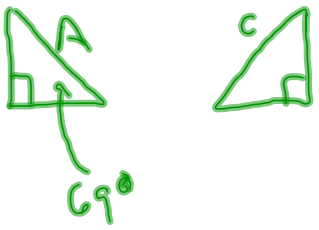
A sign is hung by three ropes as seen in the figure below. The angle between ropes A and C is 42.0 degrees, and line B bisects the angle. Find the force on ropes A and B.

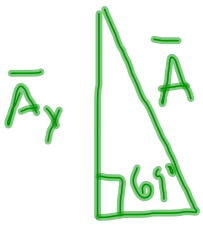




- We can only assume all y-components are equal when the problem is symmetrical (if ropes) or we are using rigid rods

$$F_B = \frac{1}{3}(33.3\ kg)(9.8\ m/s^2)$$

$$= 109\ N$$



we know $A_y = 109\ N$

$$\sin(69°) = \frac{A_y}{A}$$

$$A = \frac{A_y}{\sin(69°)}$$

$$= 117\ N$$